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POTENTIAL LASER ACTION IN HE-METAL VAPOR MIXTURES.(U)

SEP 79 J J LEVENTHAL N00014-76-C-0760

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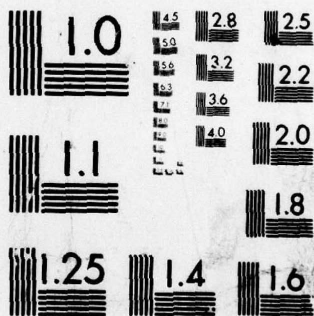

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Excited State Production
Laser
Population Inversion
Superradiant
Soft X-Ray

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Energy transfer in atomic and molecular interactions is experimentally studied by analyzing photons from radiative decay of excited species formed in the collision process. Emphasis is on production of excited states that radiate in the soft x-ray and optical regions of the spectrum. Selective excitation in such processes can lead to the inverted state distributions necessary for the laser or superradiant operation.

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Research Summary: ONR Contract No. N00014-76-C-0760

"Potential Laser Action in He-Metal Vapor Mixtures"

Principal Investigator: J. J. Leventhal
Professor of Physics
Department of Physics
University of Missouri-St. Louis
St. Louis, Missouri 63121

1. Contract Description: Experiments are performed which are designed to study energy partitioning among quantum state of atomic and molecular collision products. Emphasis is placed on processes which are potential pumping mechanisms for laser or superadiant operation in the soft x-ray to near infrared regions of the spectrum.

2. Scientific Problem: The most important aspects of this work are to determine the fundamental rules that govern internal energy level selection in molecular collisions. Using the experimental technique developed at UMSL for the study of such processes, specific collision systems can be tested for promise as lasants.

3. Scientific and Technical Approach: The experiments are performed by combining molecular beam techniques with those of emission spectroscopy. A low energy mass selected ion beam is intersected by a thermal energy atomic or molecular beam, and the radiation (soft x-ray, vuv, near uv, visible and near ir) from radiative decay of excited species formed in the collision process detected by single photon counting. By scanning the wavelength a collision-produced emission spectrum

is assembled. These spectra lead directly to information on the internal energy states of products of the interaction.

4. Progress: Incorporation of a soft x-ray-xuv spectrometer into the basic apparatus was the major experimental modification during the past year. However, studies of excited state production leading to optical emissions continued as well. Detailed experiments were performed using alkali atom beams as reactants. Computational work using mathematical models of collision systems was undertaken to provide insight into the nature of energy transfer in these collision processes.

5. Publications:

J. D. Kelley and H. H. Harris, "Curve-Crossing Trajectories, Vibronic Excitation in N_2^+-He", J. Phys. Chem. 83, 936 (1979).

G. D. Myers, J. L. Barrett and J. J. Leventhal, "Excited State Formation in Collisions Between Simple Ions and Li Atoms", Phys. Rev. A (in press).

J. L. Barrett and J. J. Leventhal, "Electron Transfer and Excitation in Low Energy N_2^+-Alakli Atom Collisions", J. Chem. Phys. (in press).

6. Extenuating Circumstances: None.

7. Personnel: J. J. Leventhal - Principal Investigator
H. H. Harris - Faculty Associate
J. L. Barrett - Postdoctoral Research Associate

8. Graduate Students Earning Degrees: None.